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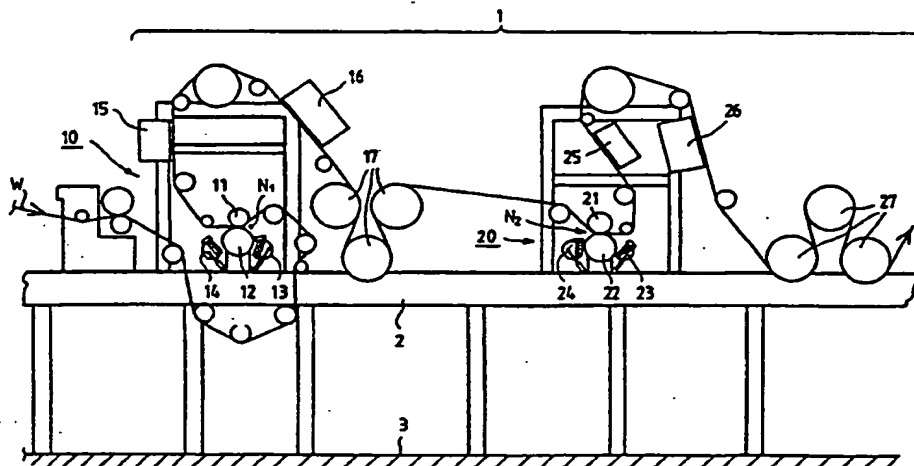
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(54) Title: METHOD AND EQUIPMENT FOR TWO-SIDED COATING OF A PRINTING-PAPER WEB



(57) Abstract

The invention concerns a method for two-sided coating of a printing-paper web with a coating paste or equivalent. In the method, the paper web (W) is passed through the coating part (1) of the paper machine, in which the first side of the web (W) is coated in the first coating station (10) of said coating part, and the coating-agent layer produced on the face of the web (W) is dried at least partly by means of a first drying unit (15, 16, 17). The second side of the web (W) is coated in the second coating station (20) of the coating part (1), and the second coating-agent layer produced on the face of the web (W) is dried at least partly by means of a second drying unit (25, 26, 27). The coating-agent layers are formed onto the paper web (W) alternatively by spreading the necessary amount of coating agent by means of a coating device (13, 24) as a film onto the face of a film press roll (12, 22), from which the coating agent is transferred in the nip (N₁, N₂) between the film press roll (12, 22) and the back-up roll (11, 21) as a coating-agent layer onto the paper web (W), or by forming the coating-agent layer directly onto the paper web (W) by means of a blade coating device (14, 23) that coats the web face while using one of the film press rolls (12, 22) as the back-up rolls of the blade coating devices (14, 23).

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Method and equipment for two-sided coating
of a printing-paper web

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The invention concerns a method for two-sided coating of a printing-paper web with a coating paste or equivalent, in which method the paper web is passed through the coating part of the paper machine, in which the first side of the web is coated in the first coating station of said coating part, and the coating-agent layer produced on the face of the web is dried at least partly by means of a first drying unit fitted after the first coating station, and in which method the second side of the web is coated after the first drying unit in the second coating station of the coating part, and the second coating-agent layer produced on the face of the web is dried at least partly by means of a second drying unit fitted after the second coating station.

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Further, the invention concerns an equipment for two-sided coating of a printing-paper web with a coating paste or equivalent in a coating part of a paper machine, which equipment comprises a first coating station for the coating of the first side of the web and a first drying unit, fitted after the first coating station, for at least partial drying of the coating-agent layer produced in the first coating station, as well as a second coating station, fitted after the first drying unit, for the coating of the second side of the web and a second drying unit, fitted after said second coating station, for at least partial drying of the coating-agent layer produced in the second coating station.

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Traditionally, printing-paper webs are coated by means of various blade or bar coaters. A problem especially with thin printing-paper webs has been poor runnability. The quality of the coating in particular in respect of smoothness is good when blade or bar coaters are used.

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In the Finnish Patent Application No. 924960, a method and an equipment are described for two-sided coating of a thin printing-paper web that contains mechanical

pulp, which method and equipment were taken to production operation at the beginning of the year 1994. In said new method, the coating agent is first metered onto the face of the film roll of a film press and transferred further onto the paper in the nip between the rolls in the film press. The first side of the web is coated in
5 a first coating station, after which the first coating layer that was formed is dried, and the second side of the web is coated in a second coating station. In respect of the runnability, the new method and equipment have fulfilled the expectations well.

In thin paper grades, with the method described above, the quality of the coating is
10 highly competitive with corresponding blade-coated grades. With higher grammages of the web, in particular by means of a blade coating equipment provided with an applicator roll or equivalent, it is possible to run larger coating quantities than with a film press and, thus, also a printing paper of a clearly higher quality.

15 In the FI Laid-Open Publication No. 79,954, an equipment is described by whose means the paper web can be coated from both sides by alternatively using either the film press technique or coating applied directly onto the web. The aim of said publication is to utilize one film press unit, by whose means both sides of the web are coated. In the method in accordance with said publication, however, no attention
20 has been paid to the coating of a thin web of low strength. Further, it is a drawback of this solution that, when the mode of coating is changed, the draw of the web becomes completely different, and, further, the construction has been accomplished so that, when film-press coating is used, the heaters that are used in order to dry the web on application of the coating directly onto the web are fully unnecessary.

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The object of the present invention is to eliminate the deficiencies in the prior-art methods described above and to provide a novel and versatile method and equipment for two-sided coating of a printing-paper web.

30 In view of achieving the objectives of the invention, the method in accordance with the invention is mainly characterized in that the coating-agent layers are formed onto the paper web alternatively by spreading the necessary amount of coating agent by

means of a coating device as a film onto the face of a film press roll, which revolves at a circumferential speed substantially equal to the web speed, from which roll the coating agent is transferred in the nip between the film press roll and the back-up roll as a coating-agent layer onto the paper web, or by forming the coating-agent layer directly onto the paper web by means of a blade coating device that coats the web face while using one of the film press rolls as the back-up rolls of the blade coating devices.

On the other hand, the equipment in accordance with the invention is mainly characterized in that each coating station comprises a film press coating unit consisting of a film roll with its metering device and of a back-up roll, at least one of which rolls is provided with at least one coating device, the coating units being alternatively usable either for film press coating, in which the coating device is arranged to spread the necessary amount of coating agent as a film onto the face of the film press roll, which revolves at a circumferential speed substantially equal to the web speed, from which roll face the coating agent is fitted to be transferred in the nip between the film press roll and the back-up roll as a coating-agent layer onto the paper web, or for blade coating, in which the blade coating device is arranged to form a layer of coating agent directly onto the web, which is passed over the film press roll so that said film press roll operates as a back-up roll for the coating device.

By means of the present invention, compared with the prior art, several advantages are obtained, of which, among other things, the following might be stated.

In the method in accordance with the present invention, thin paper grades are, as a rule, coated by means of the film press technique, and thicker paper grades are coated by means of the blade coating technique. Depending on the desired quality of the paper, the division can also be such that grades of lower quality are run by means of a film press and paper grades of higher quality are run by means of a blade coating equipment.

The difference in the quality of coating between the film press and blade coating methods is illustrated in Fig. 1. In Fig. 1, the left side illustrates the blade coating technique, in which the paper web W is passed over a roll 42 provided with a coating 43. The roll 42 forms a back-up roll for the blade applicator 41, by whose means the coating agent is spread and evened directly onto the face of the paper web W as a coating 44. The right side of Fig. 1 illustrates the film press technique, in which the paper web W is passed through a nip N formed by rolls 52,52a provided with coatings 53,53a. By means of the applicator devices 51,51a, the coating agent is spread as films F,Fa onto the faces of the film press rolls 52,52a, from which it adheres to the paper web W in the nip N between the rolls and forms the coatings 54,54a on the web faces. As can be seen from the enlarged sectional views of the paper, by means of the blade coating technique, a better smoothness of the paper is achieved, whereas, by means of the film press technique, coating layers of uniform thickness are obtained, whose advantages are uniform properties of absorption of printing ink and possibility of coating of a base paper of relatively poor brightness without resulting patches in the coating. In the method of the present invention, the running modes can also be chosen based on these reasons. Practice has proved that, among other things, owing to lack of space, on one hand, and owing to high investment costs, on the other hand, it is difficult to carry out, for example, the drying required by the coating. Thus, it is not rational to use a separate film press unit and a separate blade coating unit in the same coating equipment in order to produce a different final product of different type, i.e. a different coating paper. The present invention also provides a usable and favourable solution for this problem.

Thus, by means of the method and the equipment in accordance with the present invention, it is flexibly possible to produce all the paper grades permitted by the customary present-day techniques while optimizing the quality of the paper and the runnability of the coating process.

In addition to the fact that the method and the equipment in accordance with the present invention are suitable for two-sided coating of a base paper, as was stated above, the paper web may, of course, also have been pre-coated, for example, by

means of a film press before the two-sided coating in two stages taking place by means of the method in accordance with the invention.

Further, in the present invention, it is possible that the paper is coated or surface-sized from both sides, for example, by means of the first coating unit (film press unit) placed in the first coating station of the equipment, in which case the second film press unit placed in the second coating station is not used, or one-sided coating of the web is carried out by means of said second unit.

10 The further advantages and characteristic features of the invention will come out from the following detailed description of the invention, in which the invention will be described by way of example with reference to the figures in the accompanying drawings 2—5.

15 Figure 2 is a schematic side view of a part of a paper machine, i.e. of a so-called coating part, which is provided with an equipment in accordance with the invention for two-sided coating of a paper web by means of film presses or, alternatively, by means of blade coaters.

20 Figure 3 is a more detailed schematic illustration of the first coating unit, which is placed in the first coating station of the equipment as shown in Fig. 2, when the film press technique is used as the running mode.

Figure 4 is an illustration corresponding to Fig. 3 of the coating unit when the blade coating technique is used as the running mode.

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Figure 5 shows an alternative further embodiment in which the paper web is coated or surface-sized from both sides by means of the same coating unit.

30 Thus, Fig. 2 is a schematic side view of the coating part of a paper machine, which is denoted generally with the reference numeral 1. The reference numeral 2 denotes the frame of the paper machine, and the reference numeral 3 the base, such as the

floor of the paper mill, on which the frame 2 is mounted. The coating part 1 in accordance with the invention comprises two coating stations placed one after the other in the running direction of the paper web W, the paper web W being coated in the first coating station 10 from the first side, and in the second coating station 20 from the second side, respectively. The coating unit in the first coating station 10 is a coating unit of the film press type, which comprises film press rolls 11,12, which form a nip N_1 between them. The paper web W is passed into the nip N_1 in the way shown in Fig. 2, being guided by reversing and alignment rolls, and from the nip N_1 the paper web is passed to the first dryer unit, which consists of contact-free dryers, for example infrared dryers 15,16, which dry the side of the paper web W that was coated in the first coating station 10, as well as of drying cylinders 17.

In the embodiment shown in Fig. 2, the second film press roll 12 of the first coating unit is provided with two coating devices 13,14, of which, in the case shown in Fig. 2, the second coating device 14 has been pivoted to the opened position, while the first coating device 13 is in the running position, so that, by means of said first coating device 13, the coating agent is applied as a film onto the face of the second film press roll 12, from which it adheres to the paper web W in the roll nip N_1 . Thus, in the illustration of Fig. 2, the mode of running that is used is the film press technique. The use, operation and selection of the mode of running of the coating devices 13,14 will be described in more detail later, among other things, in relation to Figs. 3 and 4.

After the drying cylinders 17 of the first drying unit, the paper web W is passed to the second coating station 20, in which the paper web W is coated from the second side. The coating unit in the second coating station 20 is also a coating unit of the film press type, which comprises film press rolls 21,22, which form a nip N_2 between them, through which nip, with the running mode shown in Fig. 2, the paper web W is passed while guided by reversing and alignment rolls. In the way corresponding to the first coating station 10, in the second coating station 20 the second film press roll is also provided with two coating devices 23,24, of which the first coating device 23 has been pivoted to the opened position, while the second coating

device 24 is in the running position, so that the second coating device 24 spreads the coating-agent film onto the face of the second film press roll, from which the coating agent is transferred to the paper web W in the nip N_2 between the press rolls 21,22. Thus, in the illustration of Fig. 2, the same running mode is employed in each
5 coating station 10,20. From the second coating station 20, the paper web W is passed to the second dryer unit, which consists of contact-free dryers, for example infrared dryers 25,26, which dry the side of the paper web W that was coated in the second coating station 20, and of drying cylinders 27.

10 Figs. 3 and 4 are schematic illustrations corresponding to one another of alternative modes of running, which can be used in the coating stations 10,20 of the coating part as shown in Fig. 2. Figs. 3 and 4 are more detailed illustrations of the coating unit in the first coating station 10, but it is fully obvious that corresponding modes of running can also be used in the second coating station 20.

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In the illustration of Fig. 3, the running mode that is used is the film press technique, in which the paper web W is passed through the nip N_1 between the film press rolls 11,12 while guided and supported by the guide and alignment rolls 18,19. With the mode of running of Fig. 3, in which the running takes place with the nip
20 N_1 closed, a film of coating agent is applied by means of the first coating device 13 onto the face 12' of the second film press roll 12, which revolves at a circumferential speed substantially corresponding to the web W speed, from which face the coating agent is transferred onto the paper web W in the nip N_1 . Of course, it is obvious that the first film press roll 11 also revolves at a corresponding circumferen-
25 tial speed.

In one-sided film-press coating, the second film press roll 12, onto which the coating agent is applied as a film, is provided with a resilient coating in the normal way, whereas the first film press roll 11, which operates as a back-up roll, is preferably
30 a hard-faced roll, among other things, in view of easier cleaning and doctoring. The first coating device 13 is, for example, of a type as is described in the applicant's earlier FI Patent Applications Nos. 925704 and 922331, comprising an application

beam 13a, which is mounted pivotally on the frame of the film press or on a pivot arm (not shown) and which is provided with a coating head 13b. On the coating head 13b, as a doctor, for example, a large-diameter smooth rod as described in said Patent Applications Nos. 925704 and 922331 is used. The application beam 13a can be pivoted by means of pivot cylinders 13c between the running position shown in Fig. 3 and an open position. As was already described above, the second film press roll 12 is also provided with a second coating device 14, which comprises an application beam 14a provided with a coating head 14b and similarly linked pivotally and which can be pivoted by means of pivot cylinders 14c between the running position and the open position. With the mode of running shown in Fig. 3, the second coating device 14 remains pivoted in the non-operative open position.

In the illustration of Fig. 4, the mode of running that is used is the blade coating technique. First, in this mode of running, the nip N_1 between the film press rolls 11,12 is open, and the paper web W has been passed by means of the guide and alignment rolls 18,19 over the second film press roll 12, as a result of which the sense of rotation of said second film press roll 12 has been reversed, as is supposed to be indicated by means of the arrows in Figs. 3 and 4. Thus, with the mode of running shown in Fig. 4, the first film press roll 11 is not in operation. Further, the illustration of Fig. 4 differs from that of Fig. 3 in the respect that the first coating device 13 has been pivoted to the non-operative open position, whereas the second coating device 14 has been pivoted to the running position, so that the coating agent is applied and evened by means of a coating doctor placed on the coating head 14b of the second coating device directly onto the paper web W. Thus, in this embodiment, said film press roll 12 operates as the back-up roll of the second coating device 14. As the coating doctor on the second coating head 14b, it is possible to use an ordinary blade or bar coater. In a way different from Fig. 4, the upper roll, i.e. the back-up roll 11 of the film roll 12, can also be used as the back-up roll of the blade coater 14. In such a case, of course, the transfer of the web W differs from that shown in Fig. 4.

Fig. 5 shows a further alternative solution, in accordance with which the coating unit meant for carrying out the method of the present invention can be used. The coating unit as shown in Fig. 5 is a film press unit, which comprises the film press rolls 31,32 which form the nip N_3 between them, through which nip the paper web W is passed. Each film press roll 31,32 is provided with a coating device 33,34, by whose means the films of coating agent are applied onto the faces of the rolls 31,32. In the nip N_3 , the coating-agent films are transferred onto both sides of the paper web. Thus, in the exemplifying embodiment shown in Fig. 5, two-sided coating is carried out by means of one and the same coating unit. This is why the run of the web differs from the embodiments described above, because, after the nip N_3 , at both sides of the web, contact-free dryers are fitted, for example. infrared dryers 35,36, which are followed by drying cylinders 37.

As was stated earlier, in one-sided film press coating, it is preferable to use a hard-faced roll as the back-up roll in a nip. Since, in two-sided film press coating, both press rolls must be provided with a resilient coating, this requires that, in connection with a change from one-sided film press coating or blade coating to two-sided film press coating, one of the rolls in the press must be changed if a hard-faced roll was used as said roll. In the coating part, if two-sided coating of the paper web W is carried out in the first coating station 10 in the way shown in Fig. 5, the coating unit of the second coating station 20 is switched out of operation, or one-sided coating of the paper web is carried out in it.

Irrespective of the mode of running, the composition, dry solids content, and viscosity of the coating paste that is used for coating can be the same both in blade coating and in film press coating. This is the case in particular when the large-diameter smooth coating bar described above is used as the coating doctor in film press coating. The dry solids content of the coating paste can be varied favourably within the range of 50...70 %.

Above, the invention has been described by way of example with reference to the exemplifying embodiments illustrated in the accompanying figures. The invention is,

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however, not confined to the exemplifying embodiments described above alone, but different embodiments of the invention may show variation within the scope of the inventive idea defined in the accompanying patent claims.

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Claims

1. A method for two-sided coating of a printing-paper web with a coating paste or equivalent, in which method the paper web (W) is passed through the coating part (1) of the paper machine, in which the first side of the web (W) is coated in the first coating station (10) of said coating part, and the coating-agent layer produced on the face of the web (W) is dried at least partly by means of a first drying unit (15,16,17) fitted after the first coating station (10), and in which method the second side of the web (W) is coated after the first drying unit (15,16,17) in the second coating station (20) of the coating part (1), and the second coating-agent layer produced on the face of the web (W) is dried at least partly by means of a second drying unit (25,26,27) fitted after the second coating station (20), characterized in that the coating-agent layers are formed onto the paper web (W) alternatively by spreading the necessary amount of coating agent by means of a coating device (13,24) as a film onto the face (12') of a film press roll (12,22), which revolves at a circumferential speed substantially equal to the web (W) speed, from which roll the coating agent is transferred in the nip (N_1, N_2) between the film press roll (12,22) and the back-up roll (11,21) as a coating-agent layer onto the paper web (W), or by forming the coating-agent layer directly onto the paper web (W) by means of a blade coating device (14,23) that coats the web face while using one of the film press rolls (12,22) as the back-up rolls of the blade coating devices (14,23).
2. A method as claimed in claim 1, characterized in that, in film press coating, the coating agent is applied as a film onto the second film press roll (12,22), and the web (W) is passed through the closed nip (N_1, N_2) formed by said film press roll (12,22) and a back-up roll (11,21).
3. A method as claimed in claim 1, characterized in that, in blade coating, in which the coating-agent layer is formed directly onto the paper web (W), the nip (N_1, N_2) between the film press roll (12,22) and the back-up roll (11,21) is open, and the film press roll (12,22) is operated in the sense of rotation opposite to the sense of rotation in film press coating, the paper web (W) being passed over said

film press roll (12,22) through the nip between the film press roll and the blade coating device (14,23).

4. A method as claimed in any of the preceding claims, characterized in that both the first and the second coating-agent layer are formed onto the paper web (W) by means of film press coating.
5. A method as claimed in any of the claims 1 to 3, characterized in both the first and the second coating-agent layer are formed onto the paper web (W) by means of blade coating.
6. A method as claimed in any of the claims 1 to 3, characterized in that, for the formation of the first and the second coating-agent layer onto the paper web (W), different modes of running are used, i.e. either film press coating or blade coating.
7. A method as claimed in any of the preceding claims, characterized in that, in coating with each of the modes of running, as the dry solids content of the coating agent, a consistency of 50...70 % is used.
8. A method as claimed in any of the preceding claims, characterized in that, in coating with each of the modes of running, the composition, the dry solids content, and the viscosity of the coating agent are regulated substantially within the same range.
9. An equipment for two-sided coating of a printing-paper web with a coating paste or equivalent in a coating part (1) of a paper machine, which equipment comprises a first coating station (10) for the coating of the first side of the web (W) and a first drying unit (15,16,17), fitted after the first coating station (10), for at least partial drying of the coating-agent layer produced in the first coating station (10), as well as a second coating station (20), fitted after the first drying unit (15,16,17), for the coating of the second side of the web (W) and a second drying unit (25,26,27), fitted after said second coating station (20), for at least partial drying of the coating-agent

layer produced in the second coating station, characterized in that each coating station (10,20) comprises a film press coating unit consisting of a film roll (12,22) with its metering device and of a back-up roll (11,21), at least one of which rolls (12,22) is provided with at least one coating device (13,14;23,24), the coating units
5 being alternatively usable either for film press coating, in which the coating device (13,24) is arranged to spread the necessary amount of coating agent as a film onto the face of the film press roll (12,22), which revolves at a circumferential speed substantially equal to the web (W) speed, from which roll face the coating agent is fitted to be transferred in the nip (N_1, N_2) between the film press roll (12,22) and the
10 back-up roll (11,21) as a coating-agent layer onto the paper web (W), or for blade coating, in which the blade coating device (14,23) is arranged to form a layer of coating agent directly onto the web (W), which is passed over the film press roll (12,22) so that said film press roll (12,22) operates as a back-up roll for the coating device.

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10. An equipment as claimed in claim 9, characterized in that, in blade coating operation of a film-press coating unit, the nip (N_1, N_2) between the film press rolls (11,12;21,22) is open, and the film press roll (12,22) over which the web (W) is passed has been arranged to revolve in the sense of rotation opposite to the sense of
20 rotation of film press coating, the web (W) being arranged to run through the nip between the film press roll and the blade coating device (14,23).

11. An equipment as claimed in claim 9 or 10, characterized in that each film-press coating unit is provided with two coating devices (13,14;23,24).

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12. An equipment as claimed in claim 11, characterized in that both of the coating devices (13,14;23,24) of the same film-press coating unit are connected with the same film press roll (12,22).

30 13. An equipment as claimed in claim 11 or 12, characterized in that the coating devices (13,14;23,24) connected with the same film press roll (12,22) are arranged to be used alternatively so that, of the coating devices, the first/second coating

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device (13/24) is fitted to operate in film press coating and, the second/first coating device (14/23) is fitted to operate in blade coating, respectively.

14. An equipment as claimed in claim 9 or 11, characterized in that the coating
5 devices (33,34) of the film-press coating unit are connected with each of the film press rolls (31,32) so that, by means of the same unit, two-sided or one-sided treatment of the web (W) can be carried out.

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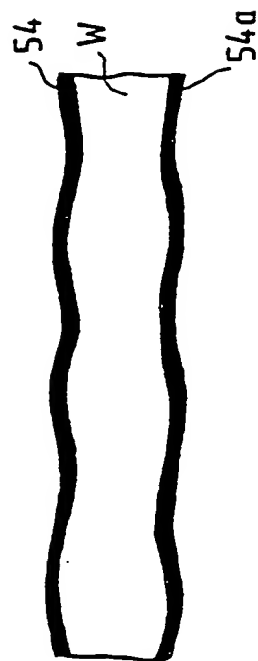
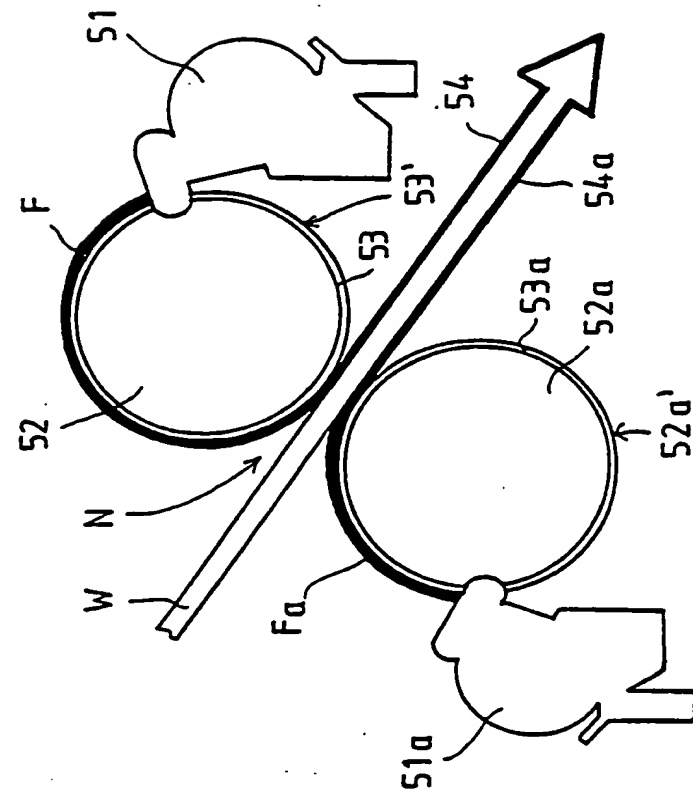
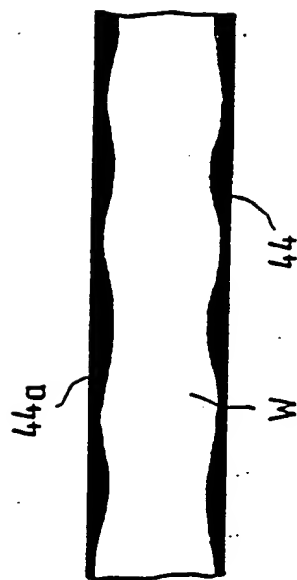
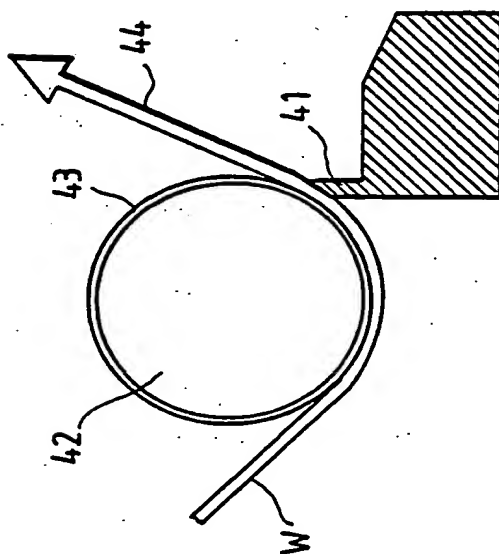


FIG. 1

PRIOR ART



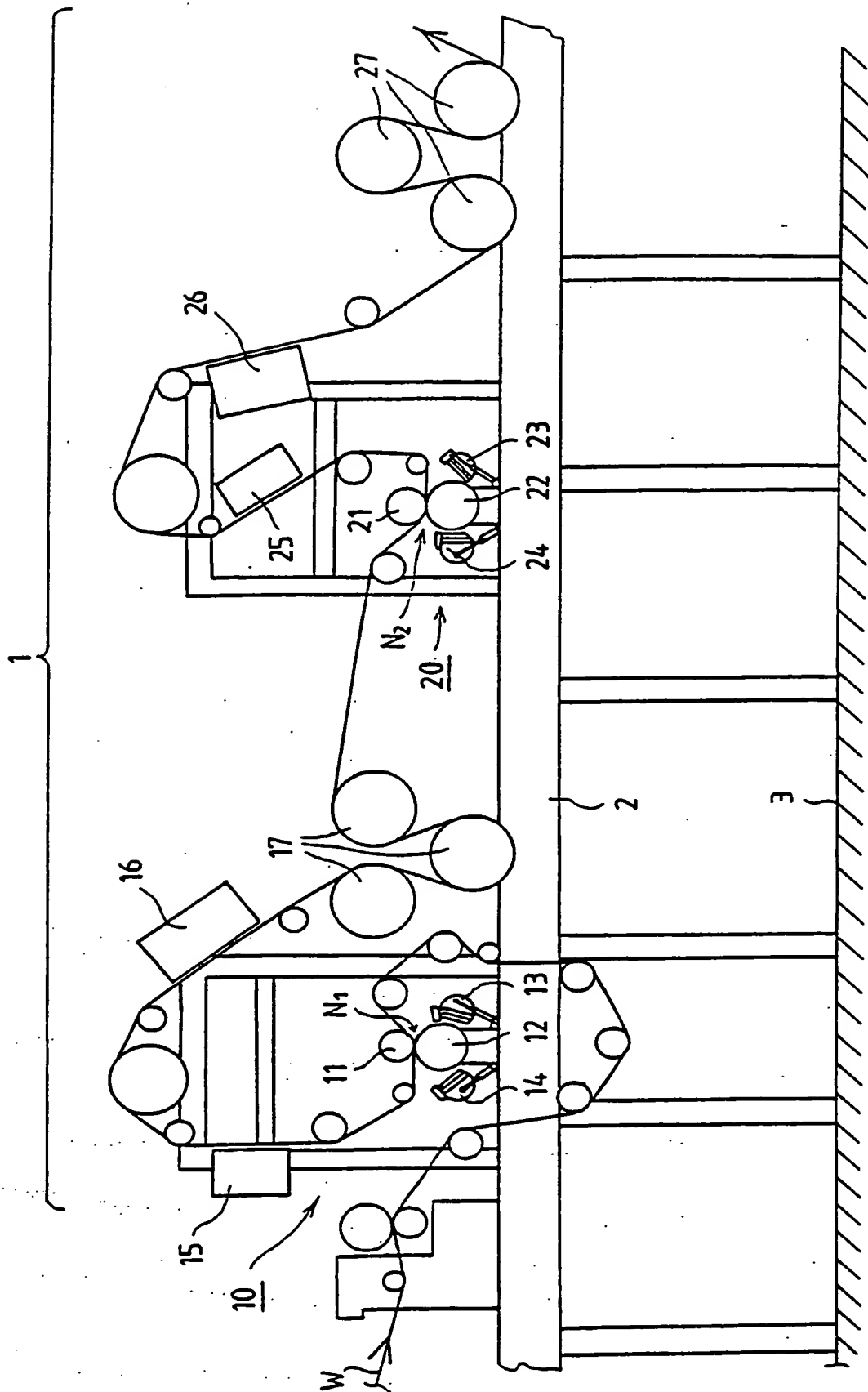


FIG. 2

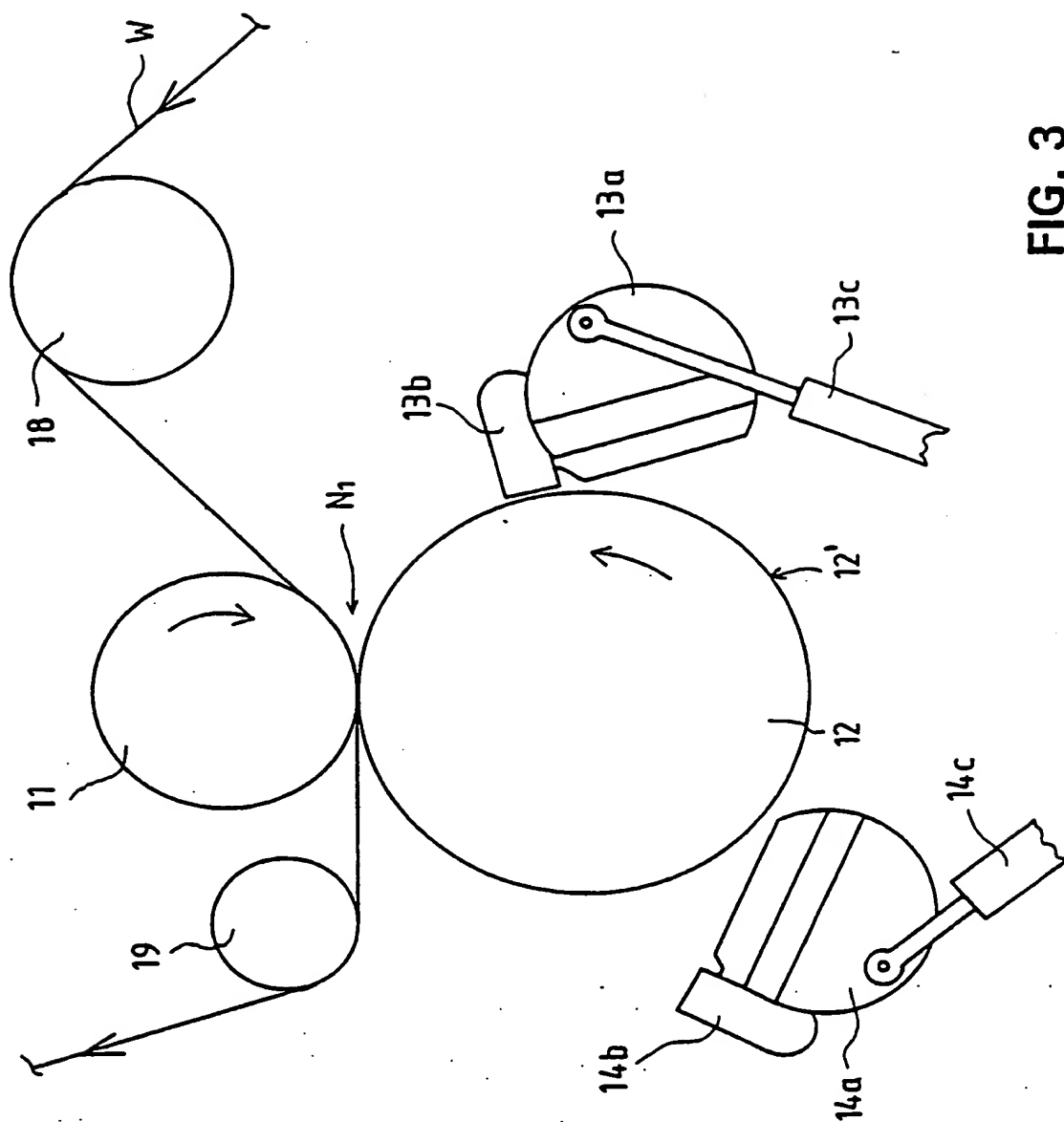


FIG. 3

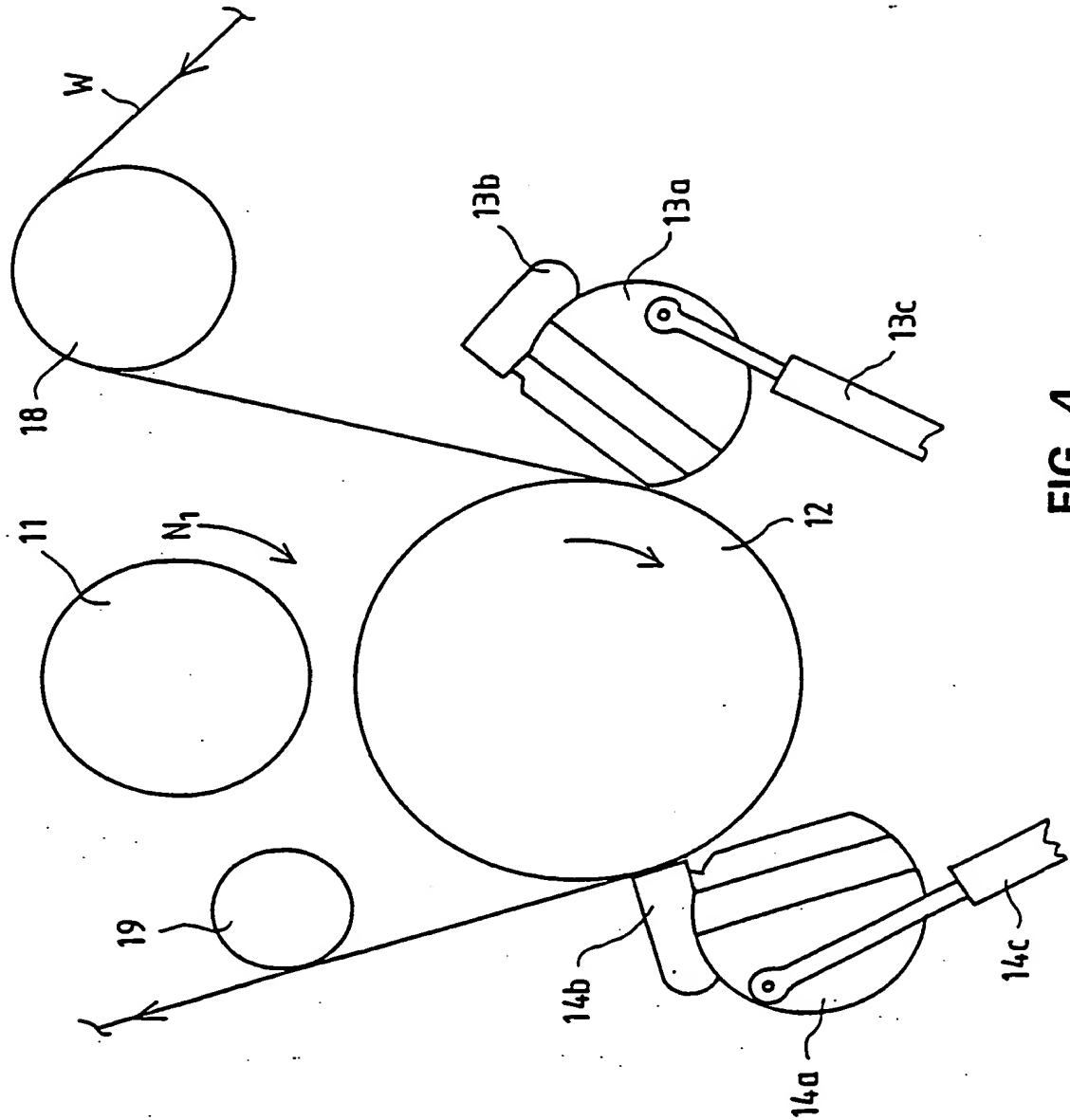


FIG. 4

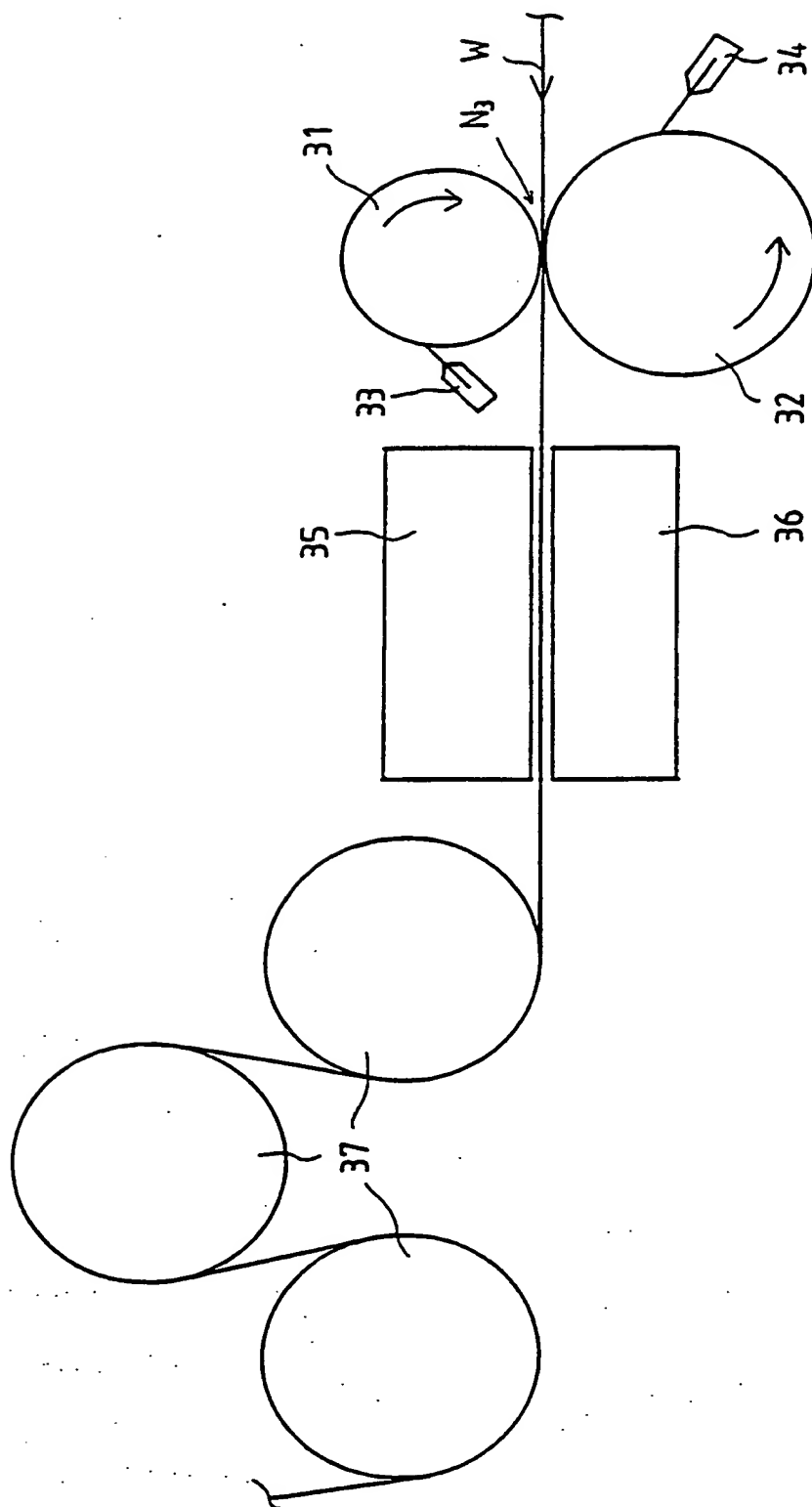


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 95/00221

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21H 23/42, B05C 1/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B05C, D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0609483 A1 (J.M. VOITH GMBH), 10 August 1994 (10.08.94), column 4, line 39 - line 56; column 6, line 8 - line 38, figures 1,3 and 6	1-11,14
A	---	12,13
X	US 4700658 A (RUDOLF BEISSWANGER ET AL), 20 October 1987 (20.10.87), claim 1, line 2-9	1-11,14
A	-----	12,13

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

28 July 1995

Date of mailing of the international search report

31 -07- 1995

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI 95/00221

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0609483	10/08/94	NONE	
US-A- 4700658	20/10/87	AT-B- 393360	10/10/91
		DE-A,C,C 3440634	07/05/86
		DE-A,C- 3540402	21/05/87
		JP-B- 7022729	15/03/95
		JP-A- 61181562	14/08/86
		SE-B,C- 465256	19/08/91
		SE-A- 8505119	08/05/86